

# **SEKAM ON-LINE CARBON-IN-ASH MONITOR**

## **APPLICATION EXAMPLES AND OPERATING EXPERIENCE**

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### **Abstract**

The 'Sekam' on-line carbon-in-ash monitor has been in service on coal fired power plants since 1988.

There are a number of reasons why operators need to measure ash carbon content such as acceptance for use by other industries, safe disposal and for monitoring boiler and burner performance.

This paper describes the principles on which the 'Sekam' operates and the range of applications for which it is used. Specific examples are described together with the benefits achieved from operating experience.

### **History**

The Sekam carbon-in-ash monitor was developed in the UK in the late 1980's. Trial systems were fitted to a 300MW unit at West Thurrock and a 500MW unit at Kingsnorth. The results of these trials were encouraging and by the end of 1991 21 Sekam units were in operation in power stations in the UK and 1 in Taiwan. Since then, additional systems have been fitted to conventional PF boiler systems within the UK and USA and more recently to fluid bed boilers in the USA and Germany. The Sekam has undergone development in recent years to refine the mechanical equipment design and electrical control systems based on operating experience.

### **Operating Principle**

The Sekam unit has within it an air operated venturi eductor which creates a suction in a small sampling pipeline system connecting the Sekam to the boiler flue duct. Two pick up probes about 1" (25mm) diameter are located across the duct and flue gas with entrained fly ash is continuously drawn into the sample pipeline and conveyed to a cyclone within the Sekam unit. The two sample probes are positioned in the duct to obtain as near representative a sample as possible and the sample point tips are designed to have the same intake velocity as the boiler flue gases, so that isokinetic sampling is achieved.

A ceramic lined cyclone separates the ash from the flue gas and feeds the ash by gravity through a pair of alternately cycling valves to a capacitance measuring chamber. The chamber is filled with ash and as the valves operate, the ash progresses through the chamber and is then conveyed through a return line to the flue duct by the air driven eductor which creates the suction for sampling.

The 'normal' location for the ash sampling points in ducts is between the air heater and the ESP or baghouse where gas temperatures are typically 130°C (270°F), however temperatures up to 315°C (600°F) are acceptable in the standard unit.

The capacitance chamber continuously measures the capacitance level of the ash that is feeding through it. The capacitance signal is then fed to a programmable logic controller which converts the signal into an indicated carbon level on the Sekam unit and also to terminals for remote reading and recording

The principle for the measurement method is based on the fact that ash is non conducting and carbon is. The percentage of carbon content directly relates to a change in dielectric strength that is measured by the capacitance cells as the ash progresses through it. The output capacitance signal is converted within the PLC to a set relationship so that the output signal which is normally a 4 - 20mA signal is proportional to ash carbon content.

The time delay between ash sampling from the duct and the output signal is typically 10 mins and is dependent on boiler load and ash content of the coal.

The operating range of the standard Sekam is 0 - 20% carbon-in-ash with an option of up to 40% for special cases such as fluid bed boilers.

The system is calibrated or checked for accuracy by taking small samples from the Sekam unit after the capacitance cell measurement section and comparing the Sekam signal to standard loss on ignition laboratory tests.

### **Application Examples**

The majority of applications have been for sampling fly ash on conventional PF fired boilers. Either one or two Sekam units are used per boiler dependent on the operators requirements and number of ducts to the gas cleaning system. Due to the Sekam's ability to sample from two points and 'average' the result. A single Sekam can simultaneously monitor two ducts on the same boiler.

On fluid bed boilers, the Sekam can be used to monitor carbon contents at much higher levels than conventional PF boilers, typically up to 40%.

Another interesting example of the use of the Sekam unit is on two recent projects where a company utilising fly ash is located on the power station. Ash is delivered from all units on the station to central storage and from there a proportion is taken off and classified by size for use. In the air classification system ductwork, a Sekam continuously monitors the carbon content and either 'accepts' or 'rejects' the ash being provided by the station. By doing this it is possible to overcome the inherent difficulty of 'knowing' the carbon content of ash which may have been produced at some time previously and put into storage.

### **Operating Experience**

Sekam monitors are now in use in a number of countries around the world, operating successfully in a variety of applications on coal fired boilers, several being designed to burn hard, low volatile coals that are difficult to burn completely and having high carbon-in-ash values. A persistently high percentage carbon-in-ash that does not respond to normal combustion trimming can of course be due to any one or a combination of many different factors. These include poor grinding performance, poor pulverised fuel distribution, mal-distribution of secondary air, or a change in coal quality.

On-line carbon-in-ash monitoring means that one parameter at a time can be established, e.g. each mill taken out of service in turn, and by having each side of the boiler monitored, information as to the location of the cause of the problem and necessary changes are more readily identified.